

**GCE**  
**Computer Science**

Unit **H046/01**: Computing principles

Advanced Subsidiary GCE

**Mark Scheme for June 2016**

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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## Annotations

Annotation	Meaning
<b>A</b>	Omission mark
<b>BOD</b>	Benefit of the doubt
<b>C</b>	Subordinate clause / consequential error
<b>X</b>	Incorrect point
<b>E</b>	Expansion of a point
<b>FT</b>	Follow through
<b>NAQ</b>	Not answered question
<b>NBOD</b>	No benefit of doubt given
<b>P</b>	Point being made
<b>REP</b>	Repeat
	Correct point
<b>TV</b>	Too vague
<b>0</b>	Zero (big)
<b>BP</b>	Blank Page – this annotation must be used on all blank pages within an answer booklet (structured or unstructured) and on each page of an additional object where there is no candidate response.
<b>L1</b>	Level 1
<b>L2</b>	Level 2
<b>L3</b>	Level 3

**LEVELS OF RESPONSE QUESTIONS:**

The indicative content indicates the expected parameters for candidates' answers, but be prepared to recognise and credit unexpected approaches where they show relevance.

Using 'best-fit', decide first which set of BAND DESCRIPTORS best describes the overall quality of the answer. Once the band is located, adjust the mark concentrating on features of the answer which make it stronger or weaker following the guidelines for refinement.

- **Highest mark:** If clear evidence of all the qualities in the band descriptors is shown, the HIGHEST Mark should be awarded.
- **Lowest mark:** If the answer shows the candidate to be borderline (i.e. they have achieved all the qualities of the bands below and show limited evidence of meeting the criteria of the band in question) the LOWEST mark should be awarded.
- **Middle mark:** This mark should be used for candidates who are secure in the band. They are not 'borderline' but they have only achieved some of the qualities in the band descriptors.

Be prepared to use the full range of marks. Do not reserve (e.g.) high Band 3 marks 'in case' something turns up of a quality you have not yet seen. If an answer gives clear evidence of the qualities described in the band descriptors, reward appropriately.

	<b>AO1</b>	<b>AO2</b>	<b>AO3</b>
<b>High (thorough)</b>	Precision in the use of question terminology. Knowledge shown is consistent and well-developed. Clear appreciation of the question from a range of different perspectives making extensive use of acquired knowledge and understanding.	Knowledge and understanding shown is consistently applied to context enabling a logical and sustained argument to develop. Examples used enhance rather than detract from response.	Concerted effort is made to consider all aspects of a system/problem or weigh up both sides to an argument before forming an overall conclusion. Judgements made are based on appropriate and concise arguments that have been developed in response resulting in them being both supported and realistic.
<b>Middle (reasonable)</b>	Awareness of the meaning of the terms in the question. Knowledge is sound and effectively demonstrated. Demands of question understood although at times opportunities to make use of acquired knowledge and understanding not always taken.	Knowledge and understanding applied to context. Whilst clear evidence that an argument builds and develops through response there are times when opportunities are missed to use an example or relate an aspect of knowledge or understanding to the context provided.	There is a reasonable attempt to reach a conclusion considering aspects of a system/problem or weighing up both sides of an argument. However the impact of the conclusion is often lessened by a lack of supported judgements which accompany it. This inability to build on and develop lines of argument as developed in the

			response can detract from the overall quality of the response.
<b>Low (basic)</b>	Confusion and inability to deconstruct terminology as used in the question. Knowledge partial and superficial. Focus on question narrow and often one-dimensional.	Inability to apply knowledge and understanding in any sustained way to context resulting in tenuous and unsupported statements being made. Examples if used are for the most part irrelevant and unsubstantiated.	Little or no attempt to prioritise or weigh up factors during course of answer. Conclusion is often dislocated from response and any judgements lack substance due in part to the basic level of argument that has been demonstrated throughout response.

<b>Assessment Objective</b>	
<b>AO1</b>	Demonstrate knowledge and understanding of the principles and concepts of computer science, including abstraction, logic, algorithms and data representation.
<b>AO1.1</b>	Demonstrate knowledge of the principles and concepts of abstraction, logic, algorithms, data representation or other as appropriate.
<b>AO1.2</b>	Demonstrate understanding of the principles and concepts of abstraction, logic, algorithms, data representation or other as appropriate.
<b>AO2</b>	Apply knowledge and understanding of the principles and concepts of computer science including to analyse problems in computational terms.
<b>AO2.1</b>	Apply knowledge and understanding of the principles and concepts of computer science.
<b>AO2.2</b>	Analyse problems in computational terms.
<b>AO3</b>	Design, program and evaluate computer systems that solve problems, making reasoned judgements about these and presenting conclusions.
<b>AO3.1</b>	Design computer systems that solve problems.
<b>AO3.2</b>	Program computer systems that solve problems.
<b>AO3.3</b>	Evaluate computer systems that solve problems, making reasoned judgements about these and presenting conclusions.

Question		Answer	Marks	Guidance
1	a	<p><b>Any 2 from:</b></p> <ul style="list-style-type: none"> <li>Allow multiple computers/resources... (AO1.1 )</li> <li>...To be treated as one/work on the same problem (AO1.1)</li> </ul> <p><b>1 from:</b></p> <ul style="list-style-type: none"> <li>Meaning all the computers can work on producing the same special effect. (AO2.1)</li> </ul>	3 <b>AO1.1</b> (2) <b>AO2.1</b> (1)	
	b i	<ul style="list-style-type: none"> <li>Gives more cycles per second</li> <li>More instructions can be executed per second</li> <li>So the program takes less time to run (1 per -, Max 2)</li> </ul>	2 <b>AO1.2</b>	Do not accept ' ...data is processed quickly...' as BP3
	ii	<ul style="list-style-type: none"> <li>More space for data/instructions in cache memory</li> <li>RAM needs to be accessed less frequently</li> <li>Accessing cache is quicker than accessing the RAM (1 per -, Max 2)</li> </ul>	2 <b>AO1.2</b>	
c		<p><b>Mark Band 3–High Level (7-9 marks)</b></p> <p>The candidate demonstrates a thorough knowledge and understanding of to what extent all three of the laws apply to this scenario; the material is generally accurate and detailed. The candidate is able to apply their knowledge and understanding directly and consistently to the context provided. Evidence/examples will be explicitly relevant to the explanation. The candidate provides a thorough discussion which is well-balanced. Evaluative comments are consistently relevant and well-considered.</p> <p><i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> <p><b>Mark Band 2 –Mid Level (4-6 marks)</b></p> <p>The candidate demonstrates reasonable knowledge and understanding of to what extent the three laws apply to the scenario; the material is generally accurate but at</p>	9 <b>AO1.1</b> (2) <b>AO1.2</b> (2) <b>AO2.1</b> (2) <b>A03.3</b> (3)	<p><b>AO1: Knowledge and Understanding</b></p> <p><i>The following is indicative of possible that candidates may refer to but is not prescriptive or exhaustive:</i></p> <p>Any individual or organisation that produces media has their ownership of that media protected by the Copyright, Designs and Patents Act. (Accept Copyright Act)</p> <p>This means other parties are not allowed to reproduce or redistribute it without permission.</p> <p>Gaining unauthorised access to a computer system is in breach of the Computer Misuse Act.</p> <p>Gaining unauthorized access with intent to commit a crime is a more severe offence under the act.</p> <p>The Data Protection Act is designed to protect personal data and focuses on the data holder</p>

Question	Answer	Marks	Guidance
	<p>times underdeveloped. The candidate is able to apply their knowledge and understanding directly to the context provided although one or two opportunities are missed. Evidence/examples are for the most part implicitly relevant to the explanation. The candidate provides a reasonable discussion, the majority of which is focused. Evaluative comments are for the most part appropriate, although one or two opportunities for development are missed.</p> <p><i>There is a line of reasoning presented with some structure. The information presented is in the most part relevant and supported by some evidence.</i></p> <p><b>Mark Band 1-Low Level (1-3 marks)</b>  The candidate demonstrates a basic knowledge of legal issues surrounding the scenario with limited understanding shown; the material is basic and contains some inaccuracies. The candidate makes a limited attempt to apply acquired knowledge and understanding to the context provided.  The candidate provides a limited discussion which is narrow in focus. Judgments if made are weak and unsubstantiated.</p> <p><i>The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.</i></p> <p><b>0 marks</b>  No attempt to answer the question or response is not worthy of credit.</p>		<p><b>AO2.1: Application</b>  <i>The selected knowledge/examples should be directly related to the specific question. The following is indicative of possible factors/evidence that candidates may refer to but is not prescriptive or exhaustive:</i></p> <p>Posting the material on the Internet would be in breach of the Copyright, Designs and Patents Act..</p> <p>As the hacker is gaining unauthorised access to the network they are breaking the Computer Misuse Act.</p> <p>As they are accessing it with the intent of committing a further crime (i.e. breaking the Copyright, Designs &amp; Patents Act) they are committing the most second serious offence under this Act.</p> <p>Were they to amend any data on the network whilst on there they would be committing an even more serious offence.</p> <p>As DPA focuses on personal data the hacker would not be in breach of this law. However if whilst on the network the hacker were able to access employee data the company could find themselves in trouble.</p> <p><b>A03.3:Evaluation</b>  The relative weights of the three acts and the impact that they have in relation to the question: copyright and patent act highly relevant if clips are shared, computer misuse act relevant due to unauthorised access, data protection act only relevant if personal data is accessed (affects company obligations not the hacker.)</p>

Question		Answer	Marks	Guidance
2	a	<ul style="list-style-type: none"> <li>(Customers enter) domain name and this is sent to DNS servers.</li> <li>DNS servers map this domain to an IP address</li> <li>If the DNS server can't resolve, it passes the request (recursively) to another DNS server.</li> <li>DNS Server sends the IP address to browser...</li> <li>... so it can retrieve the website from server on which it is hosted. (1 per -, Max 3)</li> </ul>	3 <b>AO1.2 (3)</b>	
	b	<ul style="list-style-type: none"> <li>Page will include JavaScript (which allows page content to be dynamic) (AO2.2) (1 per -, Max 1)</li> </ul> <p><b>Plus</b></p> <ul style="list-style-type: none"> <li>When a material is selected (JavaScript) code can be executed...(AO3.1)</li> <li>...the appropriate picture is shown...(AO3.1)</li> <li>...and hides the original picture. (AO3.1) (1 per -, Max 3)</li> </ul>	4 <b>AO2.2 (1)</b> <b>AO3.1 (3)</b>	Allow alternative solution using JQuery or other library/plug-ins. Accept AJAX can be used to prevent all images having to be pre-loaded. Credit 'replaces/changes previous picture with new picture' with BP 3 and 4 (i.e. 2 marks)
	c i)	<p>Ensuring the site is accessible to all. OR Ensuring customers' data is stored securely.</p>	1 <b>AO2.1</b>	Accept any other sensible consideration and measure providing the measure is ethical and not legal. (Though the two aren't necessarily mutually exclusive).
	ii)	<p><i>Measure to make site accessible:</i> Making it friendly to screen readers/using alternate text for images/taking into account colour blindness in its colour schemes/any sensible measure.</p> <p><i>Measure to secure customers' data:</i> Encrypting data/Use of firewall/Penetration testing/Any sensible measure.</p>	1 <b>AO2.1</b>	

Question		Answer	Marks	Guidance
3	a	<ul style="list-style-type: none"> <li>The program flow jumps to a (designated) label/another point in the program</li> <li>If the value in the accumulator is positive.</li> </ul>	2 <b>AO1.1</b>	Do not accept '...branch...' for BP 1
	b	<ul style="list-style-type: none"> <li>Inputs the PIN</li> <li>compares it with the passcode stored in memory using SUB</li> <li>the correct PIN results in a jump to deactivate</li> <li>incorrect PIN resulting in a jump to alarm</li> </ul>	4 <b>AO3.2</b>	Example code: INP SUB passcode BRZ deactivate BRA alarm

Question		Answer	Marks	Guidance
4	a	<ul style="list-style-type: none"> <li>• <u>Source code</u> is freely available...</li> <li>• ...for others to amend/examine/recompile</li> </ul>	2 <b>AO1.1</b>	
	b	<ul style="list-style-type: none"> <li>• (An algorithm that) makes a file storage space/size smaller ...</li> <li>• ... but accuracy with which it represents data is reduced/information is lost in the process.</li> </ul>	2 <b>AO1.1</b>	
	c	<ul style="list-style-type: none"> <li>• function takes in all three parameters and returns a string.</li> <li>• Calculates file size correctly.</li> <li>• Files under 1000MB quoted in MB</li> <li>• Files 1000MB or over quoted in GB</li> </ul>	4 <b>AO3.2</b>	<p>Example</p> <pre>function estimateFileSize(pixels, framesPerSec, lengthMins)     output = ""     fileSize = pixels * framesPerSec * lengthMins * 0.0013     if fileSize &gt; 1000000 then         fileSize = fileSize / 1000000         output = str(fileSize) + "GB"     else         fileSize = fileSize / 1000         output = str(fileSize) + "MB"     endif     return output endfunction</pre> <p>allow 1024 or 1000 KB to MB and MB to GB.</p>
	d	<p><b>Mark Band 3–High Level (7-9 marks)</b></p> <p>The candidate demonstrates a thorough knowledge and understanding of a wide range of the technical issues the coding team might have considered; the material is generally accurate and detailed. The candidate is able to apply their knowledge and understanding directly and consistently to the context provided and come to a well argued conclusion. Evidence/examples will be explicitly relevant to the explanation. The candidate provides a thorough discussion which is well-balanced. Evaluative comments are consistently relevant and well-considered.</p>	9 <b>AO1.1 (2) AO1.2 (2) AO2.1 (2) AO3.3 (3)</b>	<p>AO1: Knowledge and Understanding</p> <p>The following is indicative of possible that candidates may refer to but is not prescriptive or exhaustive:</p> <p>Java</p> <p>One version needs be written and can be used on any device/OS combination that has the Java Virtual Machine rather than having to write multiple versions.</p> <p>Code running on a VM tends to be slower than compiled.</p> <p>C++</p> <p>Multiple versions of the code will need to be maintained for different architectures...</p> <p>...however there may be minimal differences between them, and then just need compiling with different compilers.</p>

Question	Answer	Marks	Guidance
	<p><i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> <p><b>Mark Band 2 –Mid Level (4-6 marks)</b>  The candidate demonstrates reasonable knowledge and understanding of the technical issues the coding team might have considered; the material is generally accurate but at times underdeveloped. The candidate is able to apply their knowledge and understanding directly to the context provided although one or two opportunities are missed. A reasoned conclusion is drawn.  Evidence/examples are for the most part implicitly relevant to the explanation. The candidate provides a reasonable discussion, the majority of which is focused. Evaluative comments are for the most part appropriate, although one or two opportunities for development are missed.</p> <p><i>There is a line of reasoning presented with some structure. The information presented is in the most part relevant and supported by some evidence.</i></p> <p><b>Mark Band 1-Low Level (1-3 marks)</b>  The candidate demonstrates a basic knowledge of the technical issues the coding team might have considered with limited understanding shown; the material is basic and contains some inaccuracies. A conclusion is made though it may not be well supported. The candidate makes a limited attempt to apply acquired knowledge and understanding to the context provided.</p> <p><i>The candidate provides a limited discussion which is narrow in focus. Judgments if made are weak and unsubstantiated. The information is basic and lacks supporting evidence.</i></p>		<p>Program will run quicker than alternatives.</p> <p>JavaScript  As interpreted likely to be by far the slowest option.  Will run in any browser.</p> <p>AO2: Application  The selected knowledge/examples should be directly related to the specific question. The following is indicative of possible factors/evidence that candidates may refer to but is not prescriptive or exhaustive:</p> <p>Java  Multiple devices can include devices other than PCs (i.e. phones, tablets). People with unusual operating systems or architectures would have access to the application.  It makes commercial sense to sell to as wide an audience as possible.  The speed reduction compared to compiled code will likely be noticeable with such a processor intensive task.  As running on a VM coders will have limited (if any) access to some of the low level features (e.g. access to the GPU) which can optimise the program. Intermediate code is used helping protect intellectual property.</p> <p>C++  Some less used architectures may not be developed for as not commercially viable.  Compiled code will run quicker than the other options. This is likely to be noticeable given the nature of the task.  Easier to get access to lower level features (such as GPU access).  Compiled code is not human readable helping to preserve intellectual property</p> <p>JavaScript  Most people have web browsers so by far most compatible option (don't even need VM).  The slow speed may be frustrating...  ...though as no user interaction is needed this may be a trade off worth making.</p>

Question	Answer	Marks	Guidance
			<p>Source code is visible (though can be obfuscated) meaning it can easily be copied and amended.</p> <p>AO3: Evaluation Candidate has used the points above to justify their choice of language.</p>

Question		Answer	Marks	Guidance
5	a	00110111 (1 mark per nibble)	2 <b>AO2.1</b>	
	b	01101110 00000110 (1 mark for mantissa, 1 for exponent)	2 <b>AO2.1</b>	
	c	0110111 0110 (1 mark for mantissa, 1 for exponent)	2 <b>AO2.1</b>	
	d	<ul style="list-style-type: none"><li>• The variable may need to store decimal numbers.</li><li>• To store very large/small values.</li></ul>	1 <b>AO1.2</b>	Max. 1 mark

Question		Answer	Marks	Guidance
6	a	<ul style="list-style-type: none"> <li>• Data might be inconsistent...(A01.1)</li> <li>• ...For example the amount of LP-7XB toner cartridges might be reduced in one record but not in other records. (A02.2)</li> <li>• Space is wasted through redundant data... (A01.1)</li> <li>• ...For example the Re-order URL for each toner cartridge is stored multiple times. (A02.2)</li> </ul>	4 <b>AO1.1</b> (2) <b>AO2.2</b> (2)	
	b	<ul style="list-style-type: none"> <li>• Entities and relationships drawn using standard notation. (AO1.1)</li> <li>• Cartridge linked to PrinterModel, PrinterModel linked to PrinterInstance with no other links. (AO 2.1)</li> <li>• 1:M relationship from Cartridge to Printer Model (AO 2.1)</li> <li>• 1:M relationship from PrinterModel to PrinterInstance. (AO 2.1)</li> </ul>	4 <b>AO1.1</b> (1) <b>AO2.1</b> (3)	<pre>     graph LR       Cartridge[Cartridge] --- PrinterModel[PrinterModel]       PrinterModel --- PrinterInstance[PrinterInstance]   </pre>
	c	<ul style="list-style-type: none"> <li>• Storing documents being/waiting to be printed.</li> <li>• reduced buffering</li> </ul>	1 <b>AO2.1</b>	Accept 'storing information about print jobs'

Question	Answer	Marks	Guidance
7	<ul style="list-style-type: none"> <li>Prints receipt with item name and price on each line. (AO3.2)</li> <li>Applies a 10% discount to gardening purchases. (AO3.2)</li> <li>If decorating spend is £20 or more. (AO3.2)</li> <li>Displays each discount on the receipt. (AO3.2)</li> <li>Displays the correct total. (AO3.2)</li> <li>Correct addressing of a 2D array (A02.1)</li> </ul>	6 <b>A02.1</b> (1) <b>AO3.2</b> (5)	<p><b>Example</b></p> <pre> decoratingSpend = 0.0 for i = 0 to purchases[].size()     if purchases[i,1] == "Decorating" then         decoratingSpend = decoratingSpend +             float(purchases[i,2])     endif next i  total = 0.0 disc = 0.0  for i = 0 to purchases[].size()     print(purchases[i,0] + " £" + purchases[i,2])     total = total + float(purchases[i,2])     if decoratingSpend &gt;= 20 AND purchases[i,1] ==         "Gardening" then         disc = round(float(purchases[i,2]) * 0.1, 2)         print("-£" + str(disc) + " discount")         total = total - disc     endif next i print("-----") print("TOTAL: £" + str(total)) </pre>

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